7 Management and Planning Tools (7MP)

7MP Management and Planning Tools Overview

An excerpt of strategic planning tools from The Handbook for Quality Management, Second Edition by Paul Keller and Thomas Pyzdek (McGraw-Hill, 2013). Try serveral pf these tools in our Green Belt XL software.

TOOL	USAGE
Affinity diagram	Organize ideas into categories, use both sides of the brain by working in silence, work in groups.
Interrelationship diagraph	Define how factors in a situation relate to one another.
Tree diagram	Analyze a situation by stratifying ideas by increasing level of detail.
Matrix chart	Analyze correlation between two related groups of ideas (e.g., whats and hows)
Matrix data analysis	Portray correlations of multiple variables to selected important Ã¢â‚¬Å“factors‚Ã¢â‚¬Â

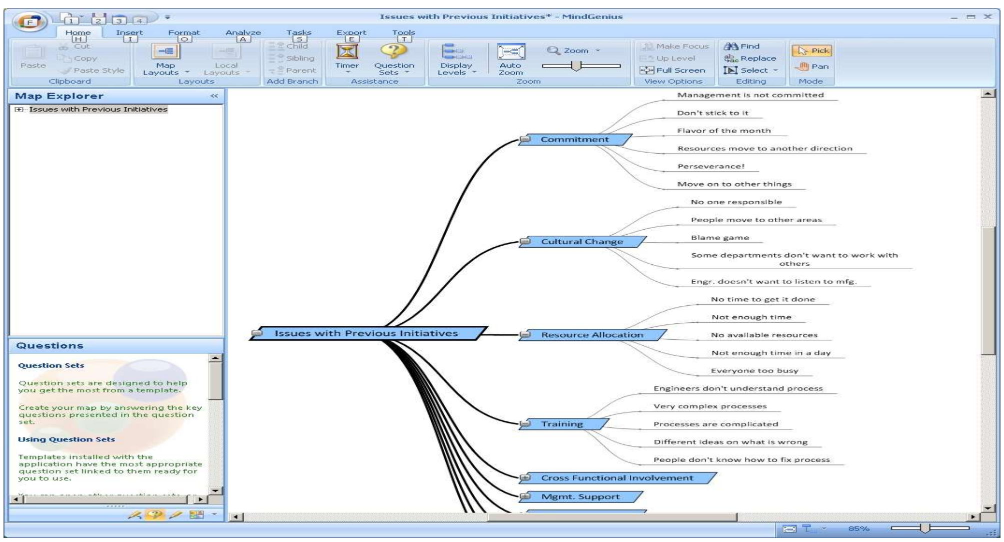
	e.g., sales of dresses of different designs versus Ã¢â‚¬Å“fitÃ¢â‚¬Â and Ã¢â‚¬Å“lookÃ¢â‚¬Â .

Activity Network Diagrams

An Activity Network Diagram deals primarily with time. This tool will help you plan how long a project will take, which jobs you can afford to delay a bit, and which jobs absolutely must be completed in a minimum amount of time.

Project management network diagrams are often (nowadays) provided by use of a gannt chart.

Affinity Diagrams



Affinity diagrams are your most basic brainstorming tools. They are used to take a chaotic jumble of thoughts and ideas and sort them into coherent groupings like in the above affinity diagram software example. They help you to see all aspects of the problem and to figure out how these aspects are related. The affinity diagram process highlights trends and patterns which otherwise might have gone unrecognized. From there, you can begin to address problems meaningfully, rather than as a scattered collection of unrelated issues.

Interrelationship Digraphs

An Interrelationship Digraph takes a group of items, problems or issues, and establishes the diverse cause and effect relationships that exist between the group items. This allows you to uncover problems which might have seemed minor, but which in reality, feed into a great number of other problems. It also helps you to find the various underlying causes behind a recurring problem that cannot be effectively addressed by itself.

Matrix Diagrams

The Matrix Diagram in Six Sigma is used to show the relationship between the various items in two or more groups. You can also show the strength or intensity of each relationship. This Six Sigma diagram helps you to recognize connections between disparate groups. Displaying all existing relationships in a graphical method will help you to make informed decisions.

Prioritization Matrix

A Prioritization Matrix is a group of L-shaped Matrix Diagram designed especially to help you prioritize or rank options. Examining how each option relates to each of your various criteria for operations and improvement gives you a quantitative and effective way to prioritize either the options available to you or the various tasks that need to be done. This is especially important if you fear that either money or time is insufficient to cover all available options. However, even if you plan to implement all options eventually, a project Prioritization Matrix will help you put the most effective tasks in motion first, thereby quickly maximizing your benefits.

When to Use a Prioritization Matrix

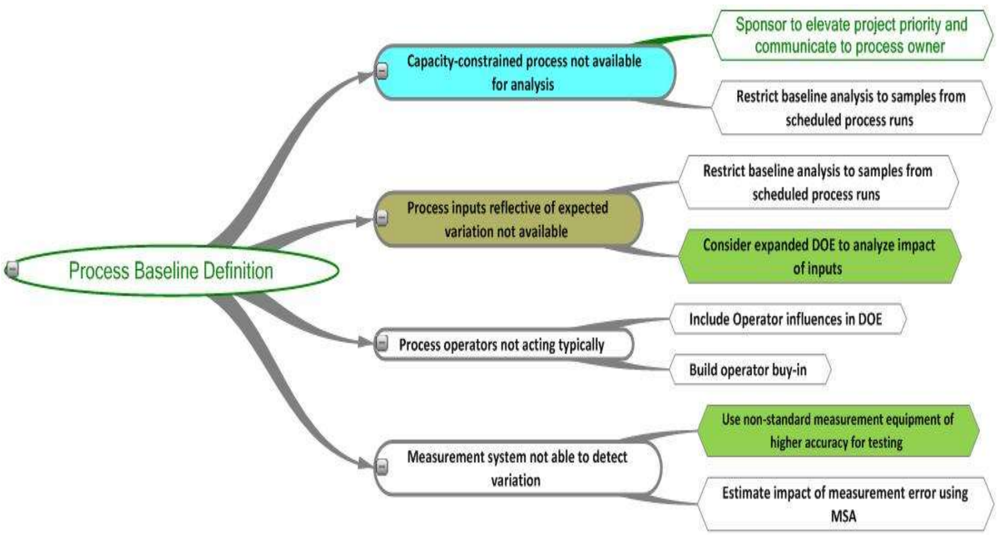
There are two methods that you can use to make a project Prioritization Matrix.

Full Analytical Method: The Full Analytical Method gives you a quantitative method for deciding which criteria are the most important to your project and which options best fulfill the given criteria. Use this method for complex projects, or projects where a mis-prioritization

could be very costly. It is especially useful when you are unsure as to which criteria are the most important.

Consensus Criteria Method: This method is somewhat simpler than the Full Analytical Method. In the Consensus Criteria Method, the planning team simply decides how important each criterion is. The options are then ranked according to how well they fulfill each criterion.

Process Decision Program Charts



Process Decision Program Charts are used to delineate the required steps to complete a process, anticipate any problems that might arise in the steps, and map out a way of counteracting the problems. With process decision program charts, you are prepared for any difficulties before they occur. A properly thought out PDPC means that no task is left undone and no unanticipated problem arises.

When to Use

As with any of the Seven Management and Planning Tools, it is important to have the right input into a PDPC. Those contributing to the creation of the chart should have a broad overview of the project, so that all steps are included, and experience with the tasks or with related tasks, so that they know what kind of problems are likely to occur.

The chart begins with a goal, placed at the top or left of the workspace. Branching off from the goal are the various steps that need to be done to achieve this goal. If necessary, there may be a second level of subsidiary tasks under this first level. These steps should not be overly

specific, so as to avoid cluttering the chart. (If your goal is to delineate very specific tasks from one large project, you are better off using a tree diagram Now try to think of any problems that might arise in the execution of each process step. Each step should be examined independently. The point of this process is to confront problems which otherwise might not have been addressed. Forcing yourself to try to anticipate problems before they occur may make you think of something you otherwise would not have even dreamed of. Additionally, this process allows people to mention points that they may find troublesome, without feeling like they are being unduly negative. Once you have thought of the problems, the next step is to think of a measure that would counteract this problem. You may think of more than one countermeasure and later decide which solution(s) you would actually like to use. For instance, suppose the anticipated problem is resistance to change among manufacturing workers. Your possible counteractive measures could be an incentive program to boost morale, or an education program to inform workers of the need for change. You can then weigh the costs and benefit of each alternative in order to decide on your course of action. Of course, it is much easier to make these decisions in the calm of the planning room, rather than in the heat of the project when you suddenly discover an unanticipated problem.

Tree Diagrams

The Tree Diagram takes a broad goal or idea and narrows it down into specific assign"ment, tasks or options. The systematic plan of attack provided by a Tree Diagram makes sure that no small task gets forgotten. In the process of creating the diagram, new and helpful ways to work towards the ultimate goal often emerge.

When to Use

Begin with the major job or goal. Think of the main tasks that must be completed in order for the ultimate goal to be achieved. The main goal should branch off into these tasks. Do not make them overly specific as of yet. A Tree Diagram should progress from general to more specific with each level. Think of what needs to be done (or what ***could*** be

done) to complete each task. These requirements and/or options should branch off from each task. Continue to create increasingly specific levels of the tree until you feel you have an exhaustive listing.

8 Traditional Quality Control Tools (8QC)

8QC Traditional Quality Control Tools Overview

An excerpt of key quality management tools from The Handbook for Quality Management, Second Edition by Paul Keller and Thomas Pyzdek (McGraw-Hill, 2013)

TOOL	USAGE
Control charts	Determine process control status; maintain statistical control.
Pareto diagram	Select most promising opportunities for improvement. Rank-order problems.
Histogram	Group data and display graphically. Visually evaluate empirical distribution of process.
Scatter diagram	Display change in one variable as another variable changes.

Flow chart	Organize information about a process in a graphical manner. Show how inputs combine to create outputs.
Cause and effect diagrams	Display all possible causes of a particular problem in an organized graphical fashion.
Check sheet	Delineate important items and characteristics, direct attention to them and verify they were evaluated.
Design of experiments	Proactively improve processes by evaluating the effect of carefully planned and controlled changes to input variables.

Cause And Effect Diagrams

Begin by brainstorming the potential relationships between the process and the outcome. The outcome, or effect, typically is stated in terms of a problem rather than a desired condition, which tends to help the brainstorming.

The major branches of the fishbone are chosen to assist in brainstorming or to categorize the potential problems afterwards. You may find it convenient to use either the 5M and E (manpower, machines, methods, material, measurement, and environment) or the 4P (policy, procedures, plant, and people) to either categorize on the final fishbone or ensure that all areas are considered during brainstorming. Categorizing the

potential causes (as branches off the spine) can be helpful in the data collection or analysis. Sub-causes (or branches) are added as needed, and it is often helpful to go down several levels of sub-causes.

Bear in mind that the causes listed are *potential* causes because there are no data at this point to support whether any of the causes really contribute to the problem. In this regard, as in all brainstorming activities, avoid judging the merits of each cause as it is offered. Only data can lead to such a judgment.

Interpreting Cause And Effect Diagrams

Use cause-and-effect diagrams to ensure that suitable potential causes are included in the data collection and analysis. If a large majority of causes in the cause and effect chart are contained in a small number of categories, consider re-categorizing to break down the larger categories.

Check Sheets

Check sheets are devices which consist of lists of items and some indicator of how often each item on the list occurs. In their simplest form checklists are tools that make the data collection process easier by providing pre-written descriptions of events likely to occur. A well-designed check sheet will answer the questions posed by the investigator. Some examples of questions are: "Has everything been done?" "Have all inspections been performed?" "How often does a particular problem occur?" "Are problems more common with part X than with part Y?" They also serve as reminders that direct the attention of the data collector to items of interest and importance. Such simple check sheets are called *confirmation check sheets*. Check sheets have been improved by adding a number of enhancements, a few of which are described below.

Although they are simple, check sheets are extremely useful process-improvement and problem-solving tools. Their power is greatly enhanced when they are used in conjunction with other simple tools, such as histograms and Pareto analysis. Ishikawa estimated that 80% to 90% of all workplace problems could be solved using only the simple quality improvement tools.

Process check sheets

These check sheets are used to create frequency distribution tally sheets that are, in turn, used to construct histograms (see below). A process check sheet is constructed by listing several ranges of measurement values and recording a mark for the actual observations. An example is shown in Figure VI.14. Notice that if reasonable care is taken in recording tick marks the check sheet gives a graphical picture similar to a histogram.

RANGE OF MEASUREMENTS	FREQUENCY
0.990-0.995 INCHES	////
0.996-1.000 INCHES	𝍸
1.001-1.005 INCHES	𝍸 ////
1.006-1.010 INCHES	𝍸 𝍸 //
1.011-1.015 INCHES	////
1.016-1.020 INCHES	//

Figure VI.14. Process check sheet.

Defect check sheets

Here the different types of defects are listed, and the observed frequencies recorded. An example of a defect check sheet is shown in Figure VI.15. If reasonable care is taken in recording tick marks the check sheet resembles a bar chart.

DEFECT	FREQUENCY
COLD SOLDER	////
NO SOLDER IN HOLE	𝍸 𝍸 ////
GRAINY SOLDER	𝍸 ////
HOLE NOT PLATED THROUGH	𝍸 𝍸 ///
MASK NOT PROPERLY INSTALLED	𝍸 ////
PAD LIFTED	/

Figure VI.15. Defect check sheet.

Stratified defects check sheets

These check sheets stratify a particular defect type according to logical criteria. This is helpful when the defect check sheet fails to provide adequate information regarding the root cause or causes of a problem. An example is shown in Figure VI.16.

SAMPLES OF 1,000 SOLDER JOINTS	PART NUMBER X-1011	PART NUMBER X-2011	PART NUMBER X-3011	PART NUMBER X-4011	PART NUMBER X-5011
COLD SOLDER	////			𝍸	
NO SOLDER IN HOLE	𝍸		//	//	
GRAINY SOLDER	𝍸	/		///	
HOLE NOT PLATED THROUGH	𝍸			///	
MASK NOT PROPERLY INSTALLED	𝍸		////	𝍸	
PAD LIFTED	/				

Figure VI.16. Stratified defect check sheet.

Defect location check sheet

These “check sheets” are actually drawings, photographs, layout diagrams, or maps which show where a particular problem occurs. The spatial location is valuable in identifying root causes and planning corrective action. In Figure

VI.17 the location of complaints from customers about lamination problems on a running shoe are shown with an “X.” The diagram makes it easy to identify a problem area that would be difficult to depict otherwise. In this case, a picture is truly worth a thousand words of explanation.

Figure VI.17. Defect location check sheet (lamination complaints).

Cause-and-effect diagram check sheet

Cause-and-effect diagrams can also serve as check sheets. Once the diagram has been prepared it is posted in the work area and the appropriate arrow is marked whenever that particular cause or situation occurs. Teams can also use this approach for historic data, when such data is available.

Control Charts (SPC)

Statistical Process Control - the use of valid analytical statistical methods to identify the existence of special causes of variation in a process.

The basic rule of statistical process control is: Variation from common-cause systems should be left to chance, but special causes of variation should be identified and eliminated.

This is Shewhart's original rule. However, the rule should not be misinterpreted as meaning that variation from common causes should be ignored. Rather, common-cause variation is explored "off-line." That is, we look for long-term process improvements to address common-cause variation.

Figure 7.7 illustrates the need for statistical methods to determine the category of variation.

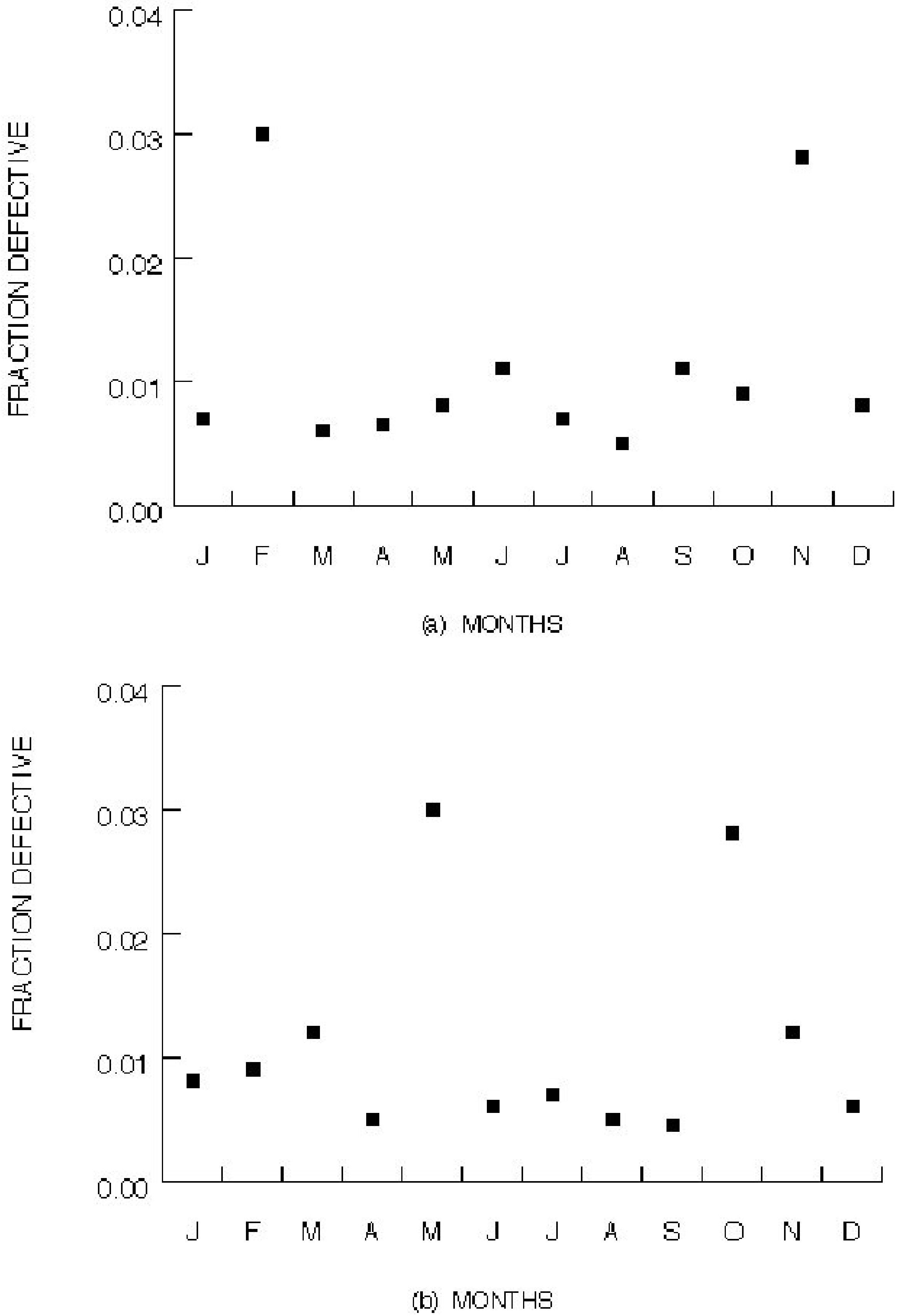


Figure 7.7. Should these variations be left to chance?

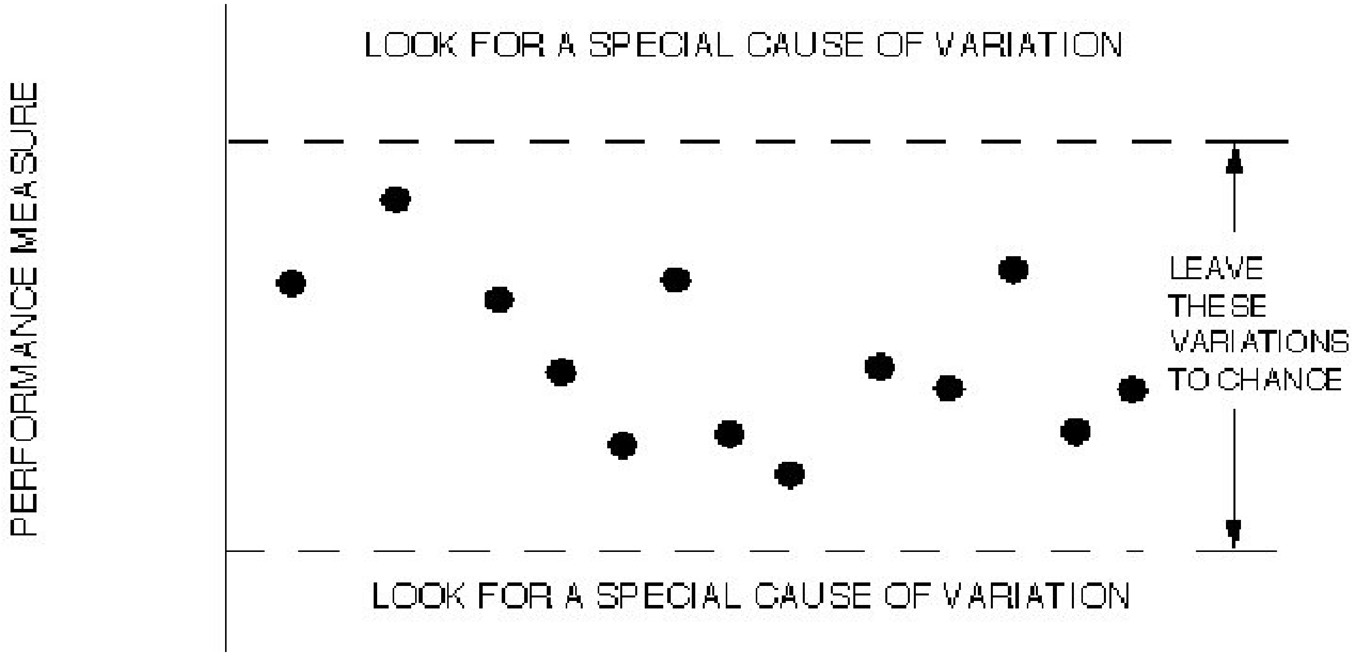


Figure 7.8. Types of variation. (From *Economic Control of Quality of Manufactured Product*, p. 13. Copyright 1931, 1980 by ASQC Quality Press. Used by permission of the publisher).

The answer to the question "should these variations be left to chance?" can only be obtained through the use of statistical methods. Figure 7.8 illustrates the basic concept.

In short, variation between the two "control limits" designated by the dashed lines will be deemed as variation from the common-cause system. Any variability beyond these fixed limits will be assumed to have come from special causes of variation. We will call any system exhibiting only common-cause variation, "statistically controlled." It must be noted that the control limits are not simply pulled out of the air, they are calculated from actual process data using valid statistical methods. Figure 7.7 is shown below as Figure 7.9, only with the control limits drawn on it; notice that process (a) is exhibiting variations from special causes, while process (b) is not. This implies that the type of action needed to reduce the variability in each case are of a different nature. Without statistical guidance there could be endless debate over whether special or common causes were to blame for variability.

See also: Responding to Special Causes of Variation

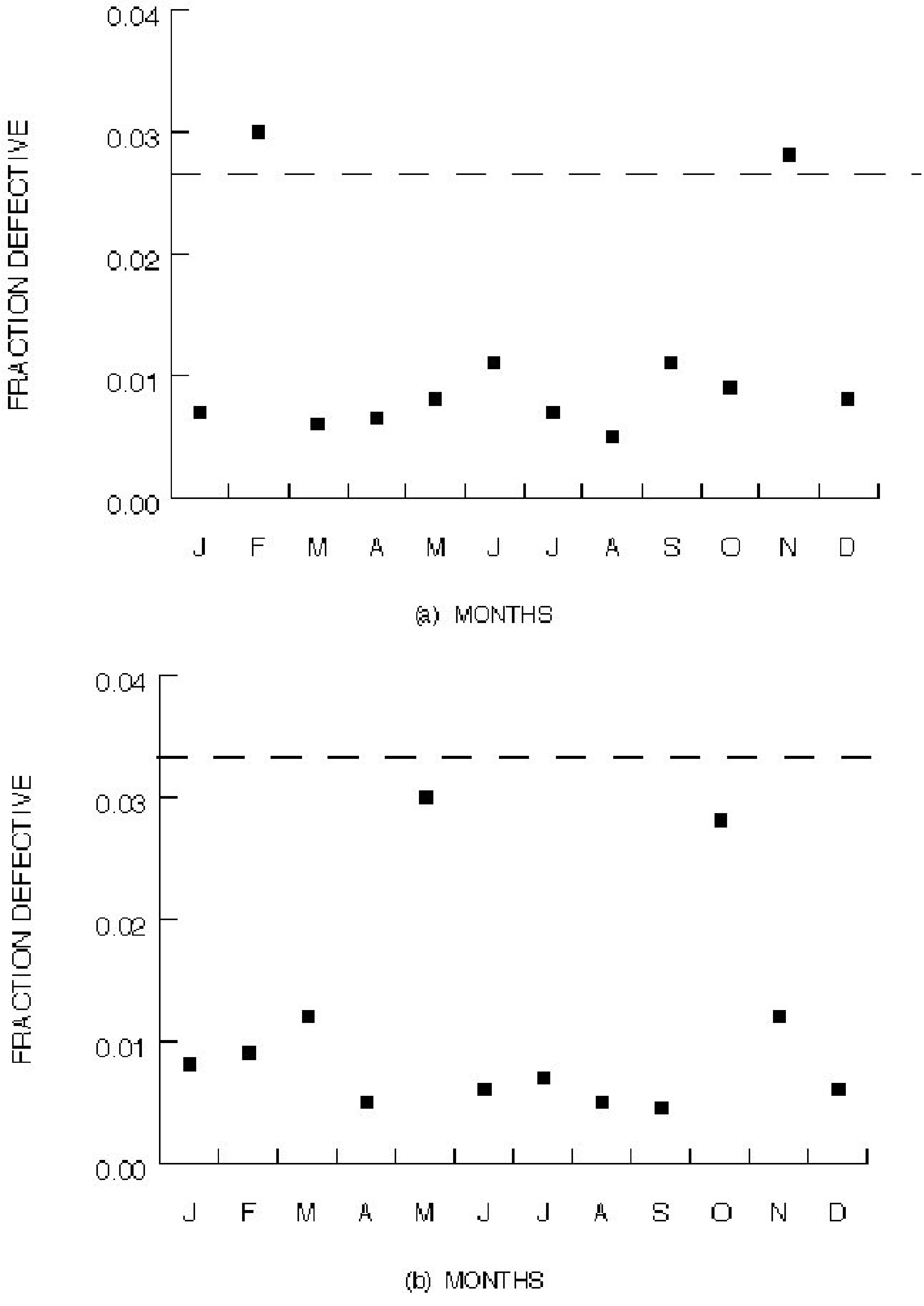


Figure 7.9. Charts from Figure 7.7 with control limits shown. (From *Economic Control of Quality of Manufactured Product*, p. 13.

Designed Experiments

A designed experiment is an experiment where one or more factors, called independent variables, believed to have an effect on the experimental outcome are identified and manipulated according to a predetermined plan. Data collected from a designed experiment can be analyzed statistically to determine the effect of the independent variables, or combinations of more than one independent variable. An experimental plan must also include provisions for dealing with extraneous variables, that is, variables not explicitly identified as independent variables.

- Response variable: The variable being investigated, also called the dependent variable, sometimes called simply response.
- Primary variables: The controllable variables believed most likely to have an effect. These may be quantitative, such as temperature, pressure, or speed, or they may be qualitative such as vendor, production method, and operator.
- Background variables: Variables, identified by the designers of the experiment, which may have an effect but either cannot or should not be deliberately manipulated or held constant. The effect of background variables can contaminate primary variable effects unless they are properly handled. The most common method of handling background variables is blocking (blocking is described later in this chapter).
- Experimental error: In any given experimental situation, a great many variables may be potential sources of variation. So many, in fact, that no experiment could be designed that deals with every possible source of variation explicitly. Those variables that are not considered explicitly are analogous to common causes of variation. They represent the œnoise level of the process, and their effects are kept from contaminating the primary variable effects by randomization. Randomization is a term meant to describe a procedure that assigns test units to test conditions in such a way

that any given unit has an equal probability of being processed under a given set of test conditions.

- Interaction: A condition where the effect of one factor depends on the level of another factor. Interaction is illustrated in Fig. 10.27.

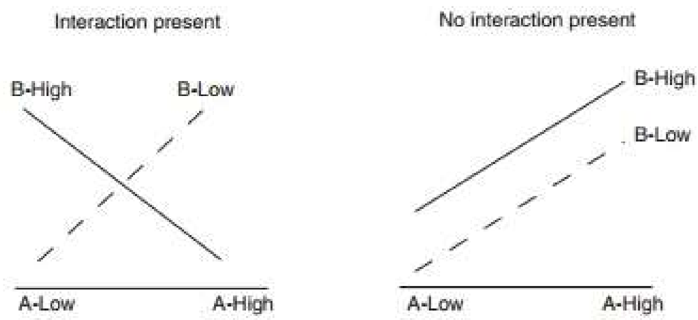


Figure 10.27 Illustration of interaction.

Flowcharts

A process flowchart is simply a tool that graphically shows the inputs, actions, and outputs of a given system. These terms are defined as follows:

Inputs: the factors of production: land, materials, labor, equipment, and management.

Actions: the way in which the inputs are combined and manipulated in order to add value. Actions include procedures, handling, storage, transportation, and processing.

Outputs: the products or services created by acting on the inputs. Outputs are delivered to the customer or other user. Outputs also include unplanned and undesirable results, such as scrap, rework, pollution, etc. Flowcharts should contain these outputs as well.

Flowcharting is such a useful activity that the symbols have been standardized by various ANSI standards. There are special symbols for special processes, such as electronics or information systems. However, in most cases activities are contained within simple rectangles; decision points within diamonds, with one input and only two potential outputs (a yes/no path).

Flowcharts can be made either more complex or less complex. As a rule of thumb, to paraphrase Albert Einstein, *Flowcharts should be as simple as possible, but not simpler*. The purpose of the flowchart is to help people understand the process and this is not accomplished with flowcharts that are either too simple or too complex.

When flowcharts indicate a large number of decision point, it is often a sign of an overly complicated process that has potential for error. Fortunately, the decision points are also a potential focus for improvement.

Process maps are flowcharts that also show, via swim lanes, how the process moves between functional areas, as shown in Figure 14.1.

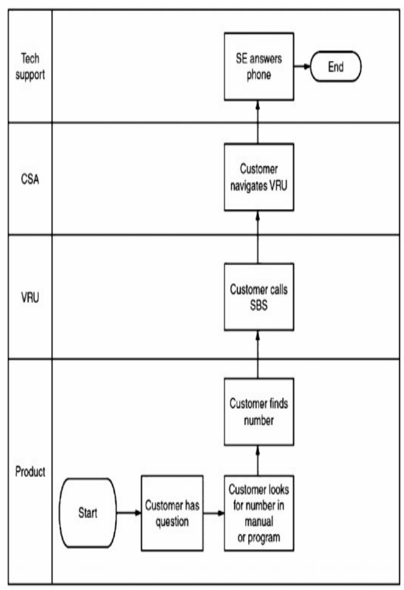
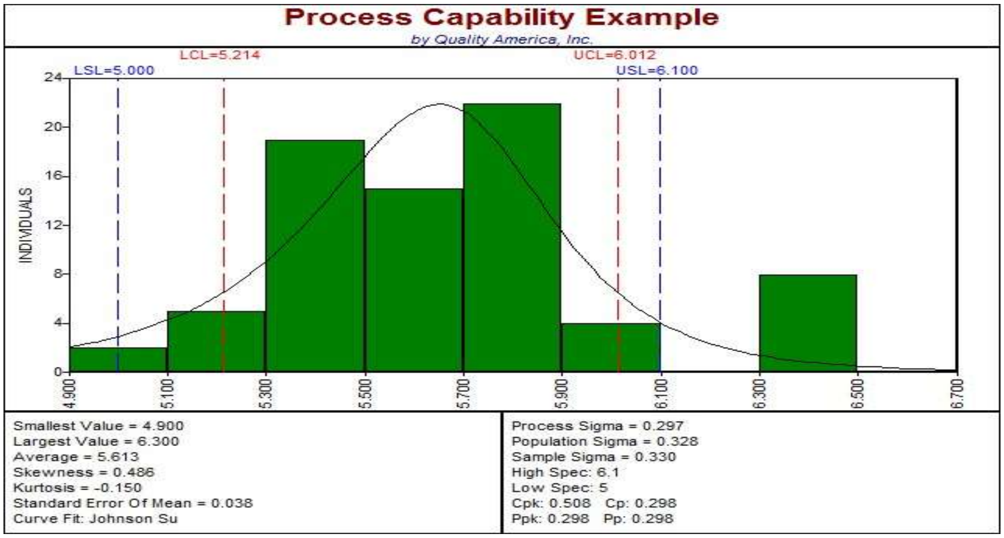


FIGURE 14.1 Example process map (Pyzdek and Keller, 2010).

Histogram



A histogram is a graphical tool used to visualize data that can be produced with histogram software such as Quality America's SPC programs. A histogram graph is a bar chart, where the height of each bar represents the number of observations falling within a range of rank-ordered data values.

METHODOLOGY

To make a histogram graph, rank order the data from the smallest value to the largest value.

Calculate the number of bars (or cells) as approximately equal to the square root of the number of data values. The number of cells (or bars) will influence the shape of the perceived distribution, so never base it on convenience, the data resolution, or anything other than the number of data observations.

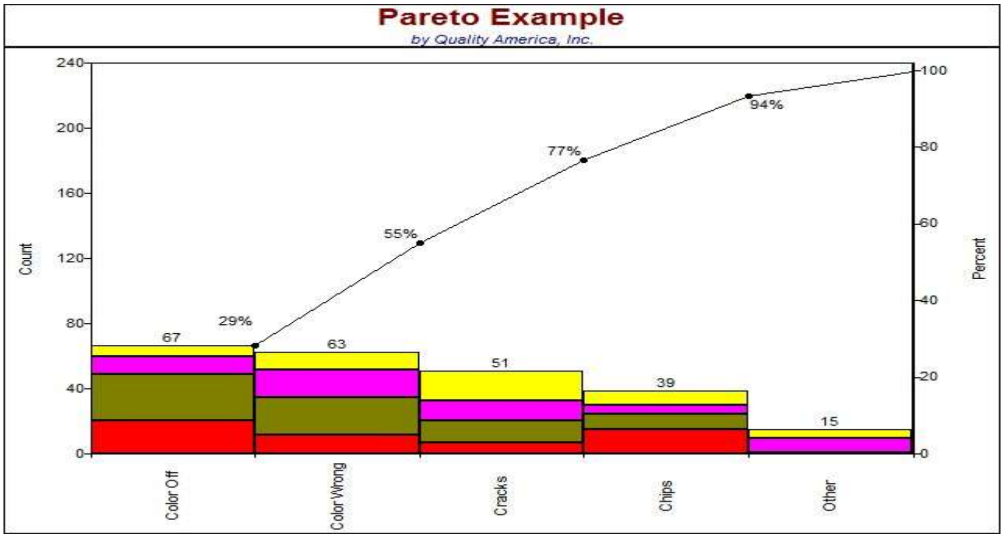
The width of each bar is calculated by dividing the range of the data (the maximum value minus the minimum value) by the number of bars.

Count the number of data observations in each bar.

The vertical axis plots the count of observations in each bar. The horizontal axis displays the data values for each bar (usually either the starting point, ending point, or midpoint).

Easy to use Histogram software is available here.

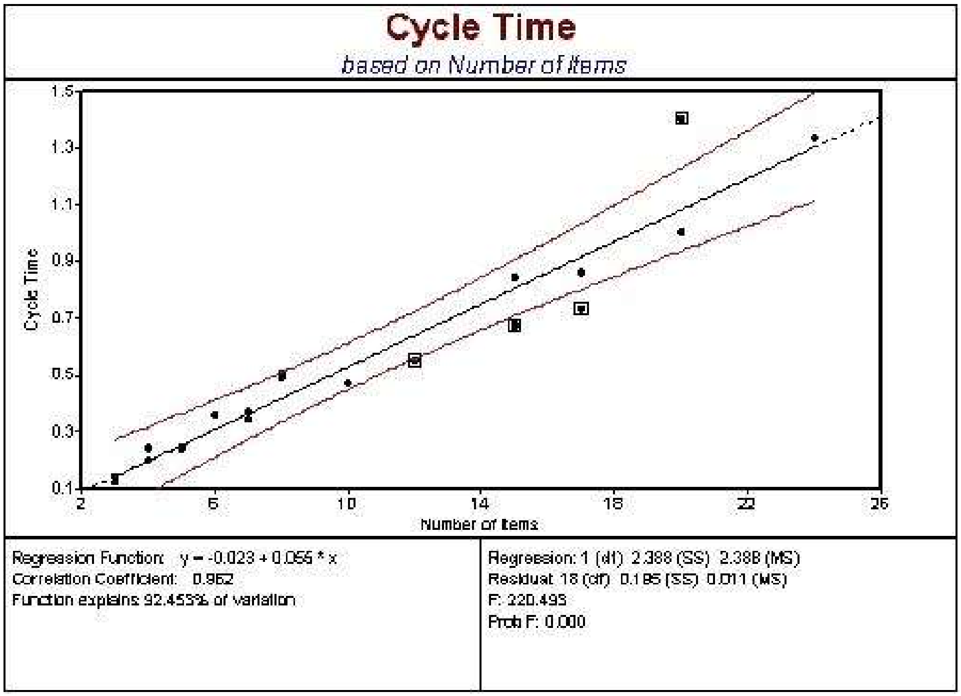
Pareto Charts



A Pareto Chart is a vertical bar graph showing problems in a prioritized order, so it can been determined which problems should be tackled first. Choose the categories (or "problem areas") to collect data for by brainstorming, or use existing data to look for these problem areas. The data you analyze must be "counts" (Attributes data) or costs, and must be additive. Data should as yields or percentages cannot be added, so are inappropriate for Pareto analysis. You should also decide the time period over which the data should be collected.

Although the height of each bar provides the primary focus of the Pareto analysis (i.e. the highest (left-most) bar indicates the highest priority), it is sometimes useful to understand the impact of sub-categories within each bar, such as shown in the figure above

Scatter Diagrams



A Scatter Diagram examines the relationships between data collected for two different characteristics. Although the Scatter Diagram cannot determine the cause of such a relationship, it can show whether or not such a relationship exists, and if so, just how strong it is. The analysis produced by the Scatter Diagram is called Regression Analysis.